(11) (A) No. 1067401

(45) ISSUED 791204

(52) CLASS 167-3.7
C.R. CL. 167-25.5

(51) INT. CL. 2 A01N 17/14, 9/30

(19) (CA) CANADIAN PATENT (12)

(54) CONTROL OF INSECTS

(70) Spragg, Walter T.,
Australia

Granted to Australian Atomic Energy Commission,
Australia

(21) APPLICATION No. 258,503
(22) FILED 760805

(30) PRIORITY DATE Australia (PC2661) 750806

No. OF CLAIMS 17 - No drawing

DISTRIBUTED BY THE PATENT OFFICE, OTTAWA.
CCA-274 (5-79)

Abstract of the Disclosure

A bait for controlling social insects such as termites comprises a cellulose material in finely divided form which is attractive as a food for the termites. Associated therewith is a second material having a significant delayed insecticidal effect on the termites. Thus, insects directly contacting and ingesting the bait will not be killed quickly but will distribute the bait within the colony by natural processes such as trophallaxis, thereby eventually killing a large number of insects.

WHAT IS CLAIMED IS:

1. A bait for eradicating termites of a colony the bait comprising finely divided particles of cellulose material which is acceptable as a food to the species of the termite to be eradicated, water, and a second material having a significant delayed insecticidal effect on the termites which ingest the bait whereby the bait is transmitted by trophallaxis through the colony and termites are killed after receiving a sufficient dose.

2. A bait as claimed in claim 1, wherein the cellulose material is fine sawdust of a selected species of timber so as to be attractive to the termites.

3. A bait as claimed in claim 2, wherein the timber is Eucalyptus tetrodonta, or Eucalyptus regnans.

4. A bait as claimed in claim 1, wherein a major proportion by weight of the bait comprises water in a bound form, and the bait is a cohesive mass.

5. A bait as claimed in claim 1, wherein the cellulose material has a particle size not exceeding 500 μm.

6. A bait as claimed in claim 1, wherein the second material is a toxic arsenic compound in particulate form of a size not larger than the size of the cellulose material.

7. A bait as claimed in claim 1, wherein the second material is a slow acting lethal material for termites, the second material being in solution form and being soaked into the cellulose material.

8. A bait as claimed in claim 7, wherein the second material comprises a cyclobuta(cd)pentalene.

9. A bait as claimed in claim 8, wherein the second material is 1,1a,2,2,3,3a,4,5,5,5a,5b,6-Dodecachloro-octahydro-1,3,4-metheno-1H-cyclobuta(cd)pentalene.

10. A bait as claimed in claim 1, wherein the water is bound into the bait in the form of a water-based Agar gel, the bait being a cohesive paste-like mass.

11. A bait as claimed in claim 10, wherein the gel comprises about 1% Agar.

12. A bait as claimed in claim 1, wherein said second material has a lethal effect within about 3 days whereby at least a substantial proportion of a termite colony can be eradicated.

13. A bait as claimed in claim 1, wherein the second material has the property of being toxic to symbiotic protozoa present in the hind gut of the termites to be eradicated.

14. A bait as claimed in claim 12, wherein the second material comprises a toxic material for termites which is relatively fast acting, the toxic material being micro-encapsulated in a material such that a relatively large delay occurs before the toxic material has an effect on termites which have ingested the bait, the toxic material being selected from halogenated polycyclic insecticides, organo-phosphorus derivatives which block specific enzyme systems and biocides selective against protozoa.

15. A bait as claimed in claim 14, wherein the toxic material is a halogenated polycyclic insecticide which is a di-methano-naphthalene.

16. A bait as claimed in claim 14, wherein the toxic material is selected from the group consisting of aldrin, dieldrin and other derivatives of aldrin, chlordane, parathion, malathion, heptachlor and bioresmethrin.

17. A bait as claimed in claim 1, wherein the second material is a micro-encapsulated termite insecticide in finally divided form, the cellulose material is in finally divided form not exceeding 500 μm and the micro-encapsulated insecticide particles are not larger than the cellulose material particles.

FIELD OF THE INVENTION

The present invention relates to the provision of a bait for eradicating termites and a method f eradication by the provision of a suitable bait at a foraging location for the termites.

PRIOR ART

Hitherto insect eradication techniques have generally relied upon the use of massive quantities of insecticide greatly in excess of the quantity of material needed to kill the number of insects involved. Not only is this wasteful of material, but more importantly potentially harmful residues of unused insecticide occur and potentially dangerous contamination of the environment can occur. The present invention is particularly concerned with the eradication of the order of insects called ISOPTERA, commonly known as termites or "white ants". Termites are not related to true ants but they do have a similar social behaviour to ants and live in colonies, the population of which ranges between hundred and millions.

Although termites live almost exclusively on cellulose in vegetable matter, the need for effective control is acute as they can cause extensive damage to other materials in their quest for cellulose, as well as destroying growing crops, grassland, forestry (especially young saplings),

household goods, stored food, and cellulose based materials such as wood, paper, cotton, fibre matter etc. The tendency to attack each of the above materials will vary from species to species.

Furthermore, evidence exists of plastic containers having been attacked by termites, the motivation behind the attack apparently not being nutritional but rather the removal of an obstruction between the termite and its food source.

Termites, like other social insects, live in colonies with a distinct social structure. In the case of subterranean termites, the social structure comprises a colony having a queen or other replacement reproductives, larvae, nymphs, workers and soldiers. Workers are responsible for basic functions including obtaining and supplying food to other termites in the colony, this food transfer being by the well-known phenomenon of trophallaxis. In a colony of social insects, generally there are certain natural processes which cause material to pass from one insect to another. In the case of termites three principal natural process occur namely trophallaxis, mutual grooming and cannibalism. In this specification the term "natural process" is used to refer to these transfer operations.

One known termite control method comprises distributing a highly toxic material, such as an arsenic containing dust, at a site of infestation in the hope that this will kill directly a worthwhile number of worker termites and in addition kill indirectly other termites in the colony which fulfil a grooming function. However, this method relies on pumping toxic dust into a termite tunnel and depositing

relatively large quantities of dust. This method places the environment at risk, and may have only limited success.

Alternative methods rely on pumping liquid or gaseous forms of toxic material into, for example, drilled holes in timber, but obvious disadvantages exist.

Another known method is particularly applicable to termites in wooden building structures. This method comprises enclosing the structure in a tent and pumping in a selected fumigant gas, usually sulphuryl fluoride. The gas is retained for 24 hours. This method is expensive and only successful on termites which come into sufficient contact with the fumigant, which of course is subsequently released into the atmosphere.

Another known technique is to spray the surface of building structures with a suitable chemical so that, although termites within the galleries in the wood are not affected by the chemical, the reproductives are killed as they leave the timber. Again, however, large quantities of toxic material must be disposed of around a structure.

U.S. patents 3,835,578 and 3,070,495 disclose a range of insecticides as being toxic to termites but the methods of these specifications can only be expected to kill largely the insects which come into direct contact with the material which must apparently be left out in substantial quantities.

SUMMARY OF THE INVENTION

The present invention in one aspect is directed to the provision of a bait to be placed at a foraging locating of termites, the bait being an acceptable food to the termites which is favoured in preference to surrounding naturally

available foods for the termites; the bait includes a material which has a delayed but lethal effect on the termite in combination with fine cellulose particles (which preferably are provided by selected wood flour) of a particle size suitable for easy ingestion by the termites, the material which has the lethal effect being in a form acceptable to the termites.

For the purpose of enhancing the desirability of the bait as food, the bait includes water in either a free or bound form. The water may assist providing the bait as a cohesive mass.

The eradication technique comprises inserting the bait into a foraging location of the termites and relying on the bait to be ingested by some of the termites of a colony whereby by natural process the bait is transferred to many other termites in the colony before any substantial lethal effect occurs so that a large number of termites can be eradicated.

The present invention permits eradication of termite colonies with a high degree of convenience, economy and effectiveness. Many of the disadvantages associated with prior art methods are avoided and in particular the use of very large quantities of potentially harmful toxic materials is obviated.

The present invention can best be practised by selecting a species of wood and a particle size to suit the species of termite to be eradicated. For example the species Mastotermes darwiniensis Froggatt is, relatively speaking, prepared to accept a wide range of baits but other species would be more selective and to optimize use of the invention for a particular

species would require simple laboratory free choice tests. With the species Mastotermes darwiniensis Froggatt, wood flour or sawdust of a particle size not exceeding 500 μm is the preferred particle size, the wood flour or sawdust passing through a 30 mesh sieve (British standard). This size of particle approximately corresponds to the size of a single "bite" of the termite and therefore is a preferred food relative to the surrounding timber at a foraging locating because the termite is not put to the trouble of tearing off the particles of wood from the timber to be consumed. The applicant has conducted tests with the species Mastotermes darwiniensis Froggatt and found that from a large number of timbers available in Australia there is a preference for the timber known as "Northern Stringybark" (Eucalyptus tetrodonta).

It has been found that it is especially advantageous to formulate the bait as a paste-like material by using a water-based gel such as a 1% Agar gel. This is believed to be particularly effective since it is thought that generally termites are under some form of water stress and the gel provides a readily available form of water and this contributes to the bait being an attractive foodstuff.

A wide range of insecticides are known and a large number are known to have a lethal effect on termites. The present invention may be practised with any toxic material which would have a lethal effect on termites providing the material is formulated into the bait according to the invention so as to have the necessary delayed lethal effect. It is preferred that the main lethal effect occurs after about three days from the first ingestion of the bait by some termites of the colony. This period of three days has been

determined by experiments conducted in the Northern Territory of Australia. A bait was prepared but with a radioactive material (which would not be lethal to the termites) in place of the toxic material for the purpose of permitting tracing of the distribution of the bait. The radioactive materials chosen were scandium-46, lanthanum 140 or gold 198, these elements being in the form of compounds insoluble in body fluids, so as to be confined to the gut and wholly involved in the normal patterns of trophallaxis and excretion. This radioactive tracing technique may be utilized in monitoring operation of the invention by including a tracer in the bait and subsequently scanning the colony location to detect bait transfer as a result of trophallaxis and excretion.

The bait was in the form of a paste inserted into a wooden dowel having a bore therein 1 cm diameter extending about 10 cm along the dowel to receive about 4 grams of the bait paste. The dowel had an external diameter of 1.25 cm. A tree at a foraging location was bored with a hole of a diameter of 1.3 cm and the dowel inserted, the bait in this case comprising fine sawdust in 1% Agar gel and containing scandium-46 as a finely ground oxide of specific activity 1 mCi per mg.

It was observed that the bait was removed rapidly and completely by the termites. Twenty four hours after bait insertion, a sample of termites was removed from one of the radioactive sites and the radioactivity associated with individual termites was determined. Further observations were made after 48 hours and 72 hours with termite samples extracted from other marked sites.

It was shown that the radioactivity associated with individuals covered a wide range after 24 hours, the range descreasing very markedly after 48 hours and still more after 72 hours.

In practising the present invention the choice of toxic material could be from a wide range of materials. Preferably the material is a material toxic to the symbiotic protozoa present in the hind gut of certain termite species. Such toxic materials include materials selected from the following classes:

(a) halogenated hydrocarbons

(b) organo-phosphorous derivatives which block specific enzyme systems

(c) biocides selective against protozoa such as heterocyclic bases.

The vast majority of possible toxic materials would, however, not have the necessary delayed lethal effect on termites if simply incorporated with the wood flour or sawdust. Therefore in certain embodiments of the invention, the toxic material is micro-encapsulated and preferably has a micro-capsule size less than the wood particle size in the bait so that the micro-encapsulated material is easily and accidentally ingested by a termite foraging for wood particles. Examples of material for the protective encapsulating coating would be hardened gelatin, gelatin-agar, gelating-gum arabic, cellulose derivates and hemicellulose. The choice depends on the digestive enzymes most active within the gut of the particular termite species to be eradicated.

Some toxic materials however, have been found surprisingly to have an intrinsic delayed effect on termites. Examples

of such materials comprise certain ars nic compounds such as arsenous sulfide and c rtain cyclobuta(cd)pentalenes such as Mirex (Trade Mark), which, as stated in the Merck Index (9th Editi n), is defined as b ing 1,1a,2,2,3,3a,4,5,5,5a,5b,6-Dodecachlorooctahydro-1,3,4-metheno-1H-cyclobuta(cd)pentalene.

Specific examples of toxic materials contemplated by the applicant suitable for use in the present invention when micro-encapsulated include aldrin and other di-methano-naphthalenes such as isodrin and dieldrin, DDT, chlordane, parathion, malathion, and heptachlor all of which are known to be toxic to termites as is disclosed in United States Patent 3,070,495. However, this patent does not make any suggestion of micro-encapsulation and is concerned with the use of a selected fungus as a specific attractant with the fast acting insecticide. Furthermore, there is the prospect of practising the present invention with pyrethroids such as bioresmethrin which are potentially less harmful to man.

For the purposes of exemplification only, specific examples of the invention will now be given.

EXAMPLE 1

A termite bait was prepared for a laboratory test in which termites of the species Coptotermes Lactus were exposed to toxic baits and compared to a control sample subjected to a similar bait but without the toxic material. Each insect sample comprised 2 grams of insects approximating 500 in number.

The first toxic bait comprised 0.8 gm Eucalyptus tetrcdonta wood flour of small particle size less than about 150 µm size mixed with 0.04 gms arsenous sulfide powder and uniformly

B

dispersed in 4 gms of 1% Agar gel. For the purposes of comparison a similar second toxic bait was prepared substituting Eucalyptus regnans flour for Eucalyptus tetrodonta flour.

It was found that the termites preferred the Eucalyptus regnans bait. After twenty-eight hours from the introduction of the bait, 1% of the termites were dead and in the control sample a similar number of termites were dead.

After forty-eight hours, 50 to 60% of the termites exposed to the toxic bait had died whereas a further 1% only of the termites exposed to non-toxic baits had died.

This example of the invention shows that sufficient delay occurs in the effect of the toxic material to permit a substantial degree of transfer by natural processes within a colony of termites.

EXAMPLE 2

Two further baits were prepared corresponding to the toxic baits of Example 1 but subject to the difference that only 0.02 gms of toxic material were included and in this case the toxic material was Mirex. Again 2 gms of termites were exposed to the two toxic baits and again the Eucalyptus regnans bait was preferentially attacked. A control sample of a similar quantity of termites was exposed to a non-toxic bait.

Again after twenty-eight hours about 1% of the termites were dead in both the toxic sample and the control sample. After ninety-six hours a further measurement was taken and it was found that 80 to 90% of the termites exposed to the toxic bait were dead or dying and cannibalism of the bodies was taking place. By contrast in a control sample a mortality rate of about 1% only was notice.

EXAMPLE 3

An insecticidal bait was made up as follows:

Wood flour of the species Eucalyptus tetrodonta was prepared using a handsaw to avoid any burning of the wood particles and sieved to produce wood flour of less than 500 μm size. The wood flour was soaked with 3% acetone solution of a slow acting halogenated insecticide, Mirex. The acetone was removed by evaporation and vacuum treatment and 20 gms of the wood flour was dispersed in 100 mls of 1% Agar gel.

A new forest plantation which was heavily infested with the species Mastotermes darwiniensis Froggatt was selected and for evaluation purposes a colony system was first traced using a radioactive tracer in a non-toxic bait. Foraging and nesting sites were flagged and two weeks later ten bait units were inserted into the foraging sites, each of the bait units comprising insecticidal bait as described above located into a cavity within a wooden dowel.

One week later the site was re-examined and the locations of foraging and nesting sectioned or excavated and sectioned. No live termites were found in the system which extended over an area of about 1 hectare and had some forty-six nesting and foraging sites. Extension invasion was noted of several species of ant and dead termites and fragments of termites could be seen.

EXAMPLE 4

The present invention has also been found applicable in an urban environment. An infestation of termites of the species Coptoternes Aeinacififorinis was found within an office complex at the Australian Atomic Energy Commission

Research Establishment at Lucas Heights in Australia. The main obviously active areas for termites were within roof beams. By radioactive tracing the colony was mapped and shown to extend along roofbeams under a verandah, under a lawn and under a concrete floor within the offices. Mirex baits were prepared in accordance with Example 3 but the wood flour particle size was reduced to be of the order of 150 µm. Subsequent inspection showed the presence of many dead termites. For a period of up to one year later further baits were left out but no evidence of any further infestation became apparent thereby leading to the conclusion that the colony was eradicated.

EXAMPLE 5

A trial was conducted at a factory and radioactive tracing demonstrated infestation of termites along concrete expansion joints and underground. Toxic baits as used in Example 4 were prepared and inserted at one expansion joint. Five days later inspection revealed dead termites and partly eaten carcasses but no live termites. It appeared the colony had been completely eradicated.

EXAMPLE 6

A bait was prepared using micro-encapsulated samples of Dieldrin.

50 ml of 12½% aqueous solution of gum acacia was emulsified at 50°C with 25 ml of peanut oil saturated with Dieldrin. 50 ml of 12½% aqueous gelatin solution was added and the pH adjusted to 6.0. The solution was gently stirred at 50°C while 375 ml distilled water was added dropwise at a rate of

40 to 50 drops/minute. When all the water was added the solution was stirred for 30 minutes and then cooled quickly at 5°C on ice. The solution was then kept at 1°C for 12 hours. The layer of encapsulated insecticide separated and hardened in a 10% gluteraldehyde solution for 24 hours. The hardened micro-capsules were separated, well washed with water and dried in a vacuum dessicator.

The micro-capsules were mixed with E regnans wood flour and dispersed in a 1% agar gel to produce the bait embodying the invention. This bait was tested by being offered to approximately 500 termites of the species Coptotermes lacteus. The termites readily consumed the bait and after 48 hours 90% had died. This compares with a natural deat rate in a control sample of 1%.

It is preferable that the Dieldrin be relatively freshly encapsulated since after a period of storage of the order of ten days or more some degree of leakage of the Dieldrin from the micro-capsules may occur and this can adversely effect the results obtained.

Tests have been conducted with a similar bait but without micro-encapsulation of the Dieldrin. It was found that a substantial proportion of termites die quite quickly although the bait shows little sign of being touched. This is thought to be due to the vapour of Dieldrin having a toxic effect and although termites in proximity to the bait are killed quickly, Dieldrin without micro-encapsulation would not be useful for eradicating colonies.

The invention can be implemented efficiently. It has been estimated that a typical termite colony may comprise 10^6 insects at an average weight of 50 mg.. Based on the

assumption the insects will be killed in four days and allowing for seven-eighths of the bait to be eliminated by excretion, it has been estimated that a total weight of bait of 125 gms only is required and when Mirex is used only 0.8 gms is required. In fact due to cannibolism, the amount of toxic material required should be less than this quantity.

In the text described above, it was estimated that the colony comprised 7 x 10^6 insects and the total bait set out amounted to 1 kg. On subsequent inspection it was found that only 250 gms of bait had been removed and dissection of the colony and foraging point dislosed a complete kill of the colony. Thus, approximately 1 gm of a toxic material such as Mirex can kill a colony of the order of 10^6 termites.

EXAMPLE 7

A trial was conducted using freshly encapsulated malathion, the bait being otherwise in accordance with Example 6. A termite colony had been located as being active in a skirting board and wall panelling. A bait was left out and after 24 hours was found to be partly removed. After four days it appeared that the colony had been killed. By contrast laboratory tests with baits which had been stored for a week or two after encapsulation of malathion or dieldrin were not readily accepted by the insects probably due to a slow release of the contents of the micro-capsules.